



# **Local Government Sustainable Energy Coalition**



## **Microgrids, Resilience, PERCs** **The Santa Rita Unified School District Story**

September 18, 2018 | Webinar

# Webinar Outline

## 1) Introduction to Microgrids

- Definition, elements, values

## 2) "Microgrids, Resilience, PERCs" Video

## 3) SRUSD Story

- Basic Design
- Sizing the System
- Addressing "the Perfect Storm"
- The Rate Component
- Solar and Battery Locations
- Financing
- Construction
- Long-Term Benefits

## 4) Scaling the Model

- To school districts with and without solar
- Taking the model to city facilities, universities, and other institutions

## 5) Bringing PERCs to Campbell Union High School District

- Existing Solar
- Seeking Grants -- FEMA application

## 6) Lessons Learned

## 7) Questions and Answers



*The cost-effective greening of cities, corporations, and campuses is our mission*

Cities



Corporations



Campuses



Owner's Reps | Honest Brokers | No Industry Ties

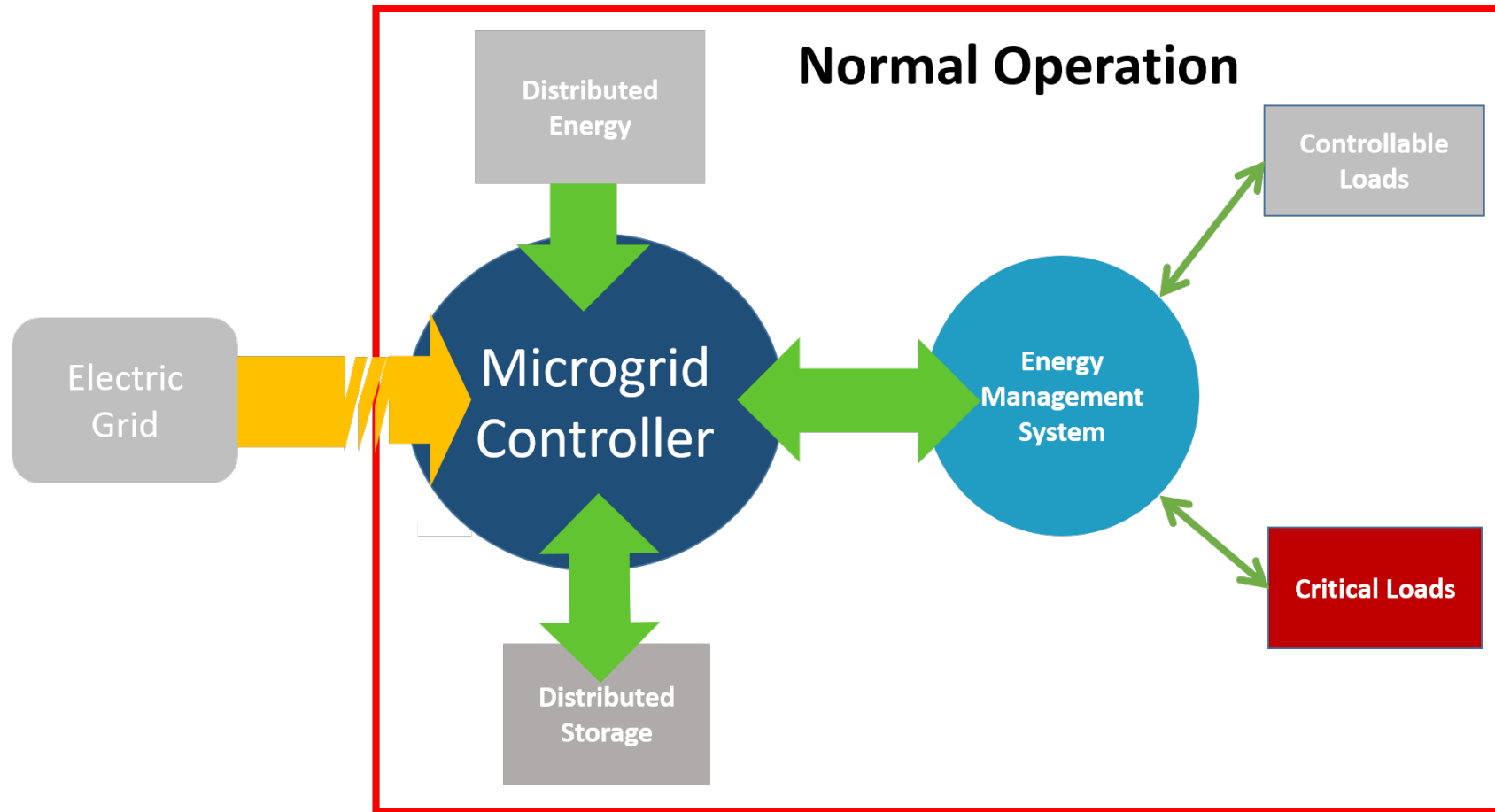
### Current Clients:

- City works: Santa Monica, Beverly Hills, Burbank, Anaheim
- Solar consultants for LA Metro, Capital Group, Cathay Bank, Valley Indoor Swap Meet, Orange Unified School District, Solsmart with the South Bay COG, Promenade West, Millbrook School (NY), Northwest Corporate Center (AZ)
- School District Energy Managers for
  - GGUSD, PUSD, SSD, CSD, SRUSD, CUHSD, and others; >130 campuses; three charter schools

### Specialize in Demonstration Projects Including:

- Long Beach Airport Solar Alley
- Efficiency Partnerships w/ SCE, SCG, SDG&E
- Demand Response partnership w/ PG&E
- Miami City Hall Solar Trees
- Cathay Bank with Gensler Architects, El Monte
- Save a Ton Student Rallies
- Emissions Time Bomb demonstrations
- Zero Net Energy Pilot w/SCE and SCG

# 1) Introduction to Microgrids





# Defining Microgrids

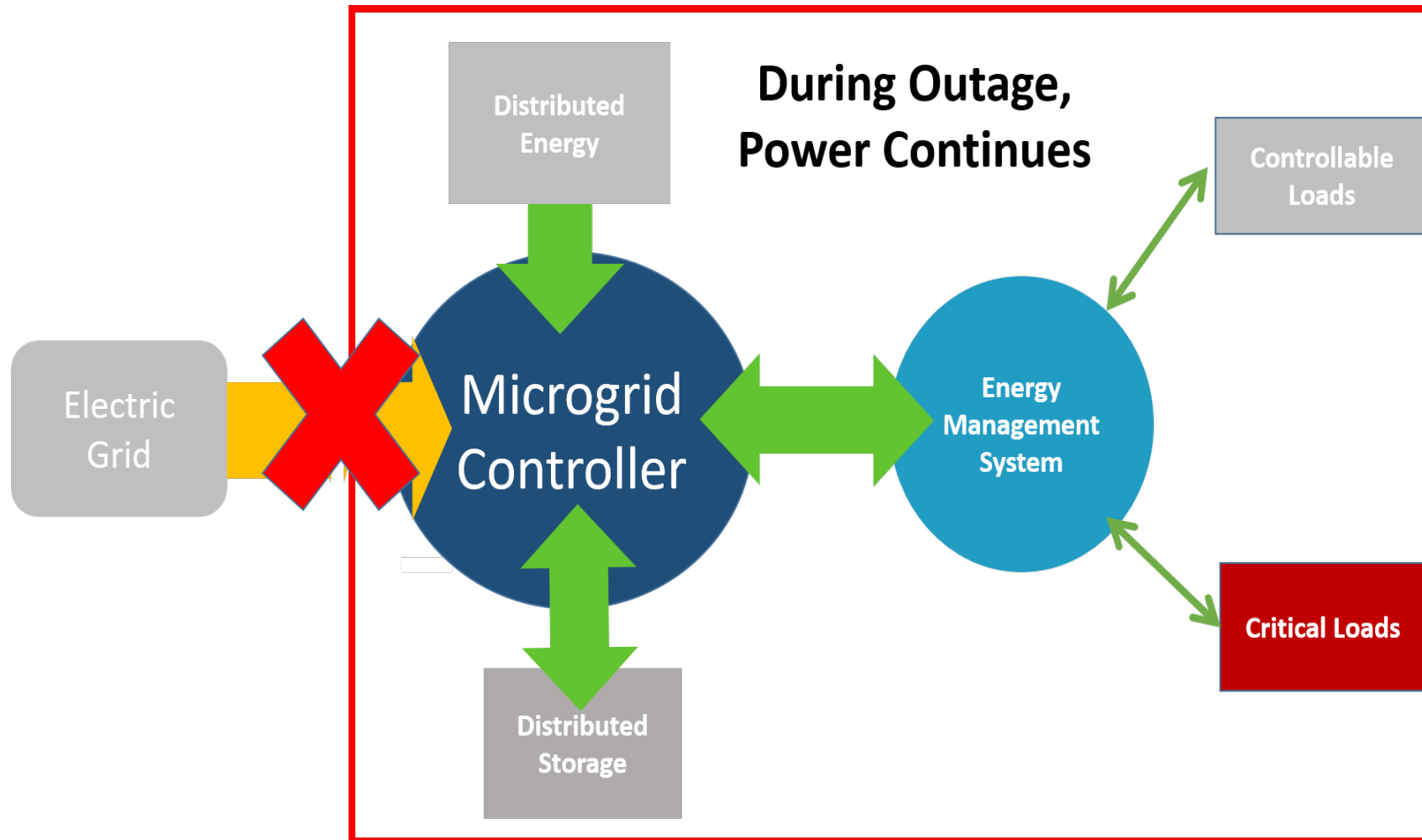
A microgrid is a group of interconnected loads and distributed energy resources within a clearly defined electrical boundary that acts as a single controllable entity.

A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or “island-mode.”

# Four Fundamental Elements for Carbon-Free Microgrids

1. Microgrid Controller – MGC controls the system. Managing between supplies and demand
2. Distributed Energy – Renewable/Solar power resources generate onsite green power
3. Distributed Storage – Batteries store for daily use and emergencies
4. Energy Management System – EMS controls demand during outages

# Powered Emergency Response Centers (PERCS)



# CASE STUDY | Thomas Edison's Pearl Street Station

## First Power Station in the U.S.

- The first microgrid!
- Operated from 1882 to 1889
- Initial load of 400 lamps at 82 customer sites





# CASE STUDY | Co-Op City's Microgrid, The Bronx

**24 MW peak load**

**40 MW combined cycle trigen unit**

60,000 residents; 14,000 condos

34 towers, 35 clusters of townhomes, shopping centers, movie theaters, high school, 2 middle, and 3 elementary schools

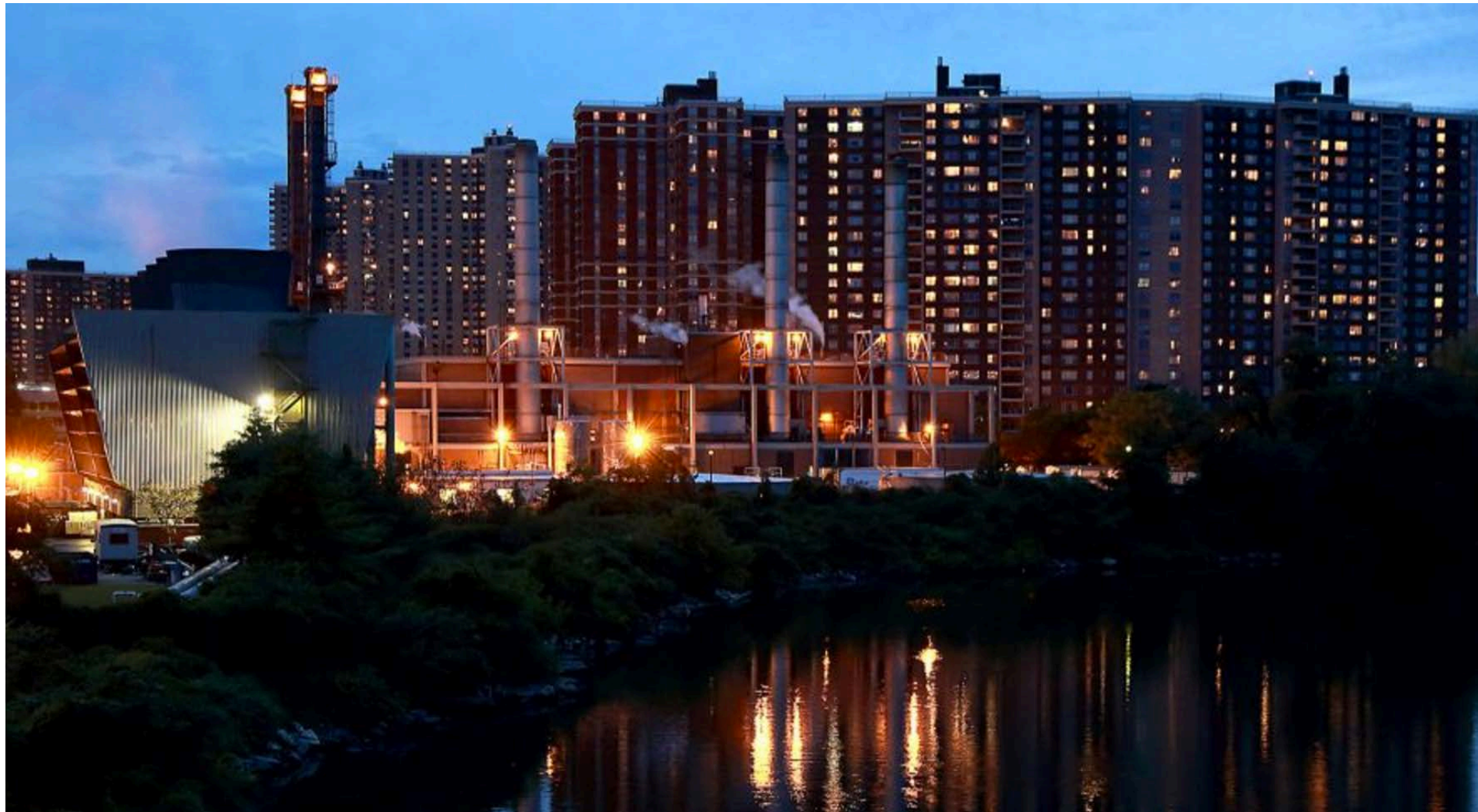
Early 2000s: Feasibility study of replacing aging central heating plant and 6 MW back-up generator

2001: 40 MW combined cycle, trigeneration plant commissioned. Provides heating, cooling and power. Excess power sold to ConEd

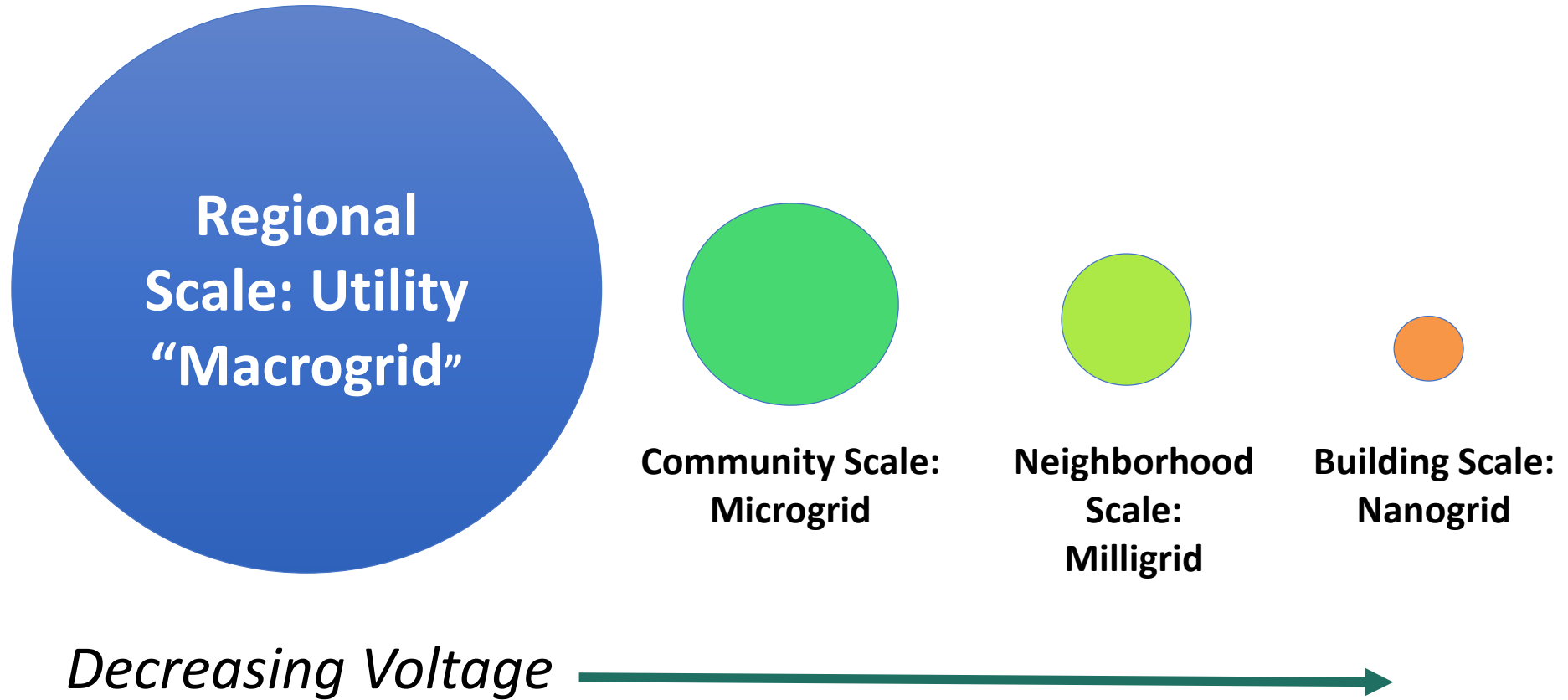
Annual savings: **\$15 million/year**



# CASE STUDY | RiverBay Cogeneration Plant



# Grids Work at Different Scales











# Gensets Now Idle Most Summer Days





# 350 kW of SolarWorld Panels





# CASE STUDY | Brooklyn Microgrid Project

## Park Slope, Boerum Hill, and Gowanus



# Brooklyn Microgrid Project

- Peer to peer transactions through installation of TransActive Grid Element devices
- Blockchain technology accounts for transactions, manages sales/purchases
- Prosumers generate smart meter tokens that are then sold to neighbors whose smart meters consume them
- So far more than 130 buildings: brownstones, public housing, fire station, gas station, and a grocery

# CASE STUDY | Stone Edge Farm Microgrid

- 16 acre organic farm/vineyard
- Bordeaux-style varietals
- Goal to cut its carbon footprint by 50%
- 7 solar arrays
- 300 solar panels
- Four types of batteries, Aquion and Tesla
- Capstone microturbine
- Electrolyzer to create hydrogen fuel
- Toyota Mirai... a hydrogen fuel cell ride!





# Other Celebrated Microgrids...

- Harvard University
- Princeton University
- New York University
- Alcatraz Island

# The Values of Microgrids

- Energy resilience for short-term outages
- Energy supplies during natural disasters
- Carbon-free operations
- Manage the integration of renewable energy on the grid
- Reduce greenhouse gas emissions
- Increase use of storage, EV's, and distributed energy resources
- Grid, ancillary services support

## 2) The PERC Video



SRUSD student talks about the microgrid project



Ted speaks with Jigar Shah about their experience on the SRUSD project

**Powered Emergency Response Centers (PERCs) at Santa Rita Union School District**

**<https://youtu.be/82a1mRV3ITk>**

### 3) The SRUSD Story





# The City of Salinas



The Home of Steinbeck  
“The Salad Bowl of the World”





# SRUSD at a Glance

- Six school sites
  - Four elementary
  - Two middle schools
- District Office
- Serving students from Salinas and Monterey County
- Largely Hispanic student body
- EcoMotion retained in October 2015 as SRUSD's energy consultant



**Santa Rita**  
**Union School District**



# EcoMotion hired to help SRUSD get batteries

- SRUSD wanted students to be able to “shelter in place” during outages
- SRUSD staff and Board members had heard of Tesla’s Gigafactory
- Aware of what EcoMotion calls the “Lithium-Ion Revolution”
- Wanted batteries to cover 7-hour school days
- Retained EcoMotion to help find a solution
- EcoMotion tabulated average loads and determined how much battery capacity would be needed...and the cost!

# Initial Analysis of 7-hour Energy Storage Requirements

Bolsa Knolls	72 kW	504 kWh
Gavilan View	72 kW	504 kWh
La Joya	39 kW	273 kWh
McKinnon	47 kW	329 kWh
New Republic	78 kW	546 kWh
<u>Santa Rita</u>	<u>75 kW</u>	<u>525 kWh</u>
<b>Total</b>	<b>383 kW</b>	<b>2,681 kWh</b>

*Based on average peak demand during school hours*

**EcoMotion estimates ~\$3.5 - \$5.5 million in batteries  
and controls for all six campuses**

# EcoMotion's Solutions

- Solar proposed to cover 100% of the District's power bill
- Solar savings – thanks to a rate switch – pays for storage
- SolEd Benefit Corp offered a PPA for an integrated system at parity (24.18¢ / kWh)
- SolEd agrees to build ~1 MW of solarports plus 1,096 kWh of storage, integrated as microgrids that can “island” during outages
- Prop 39 funds were used for advanced energy management system to control curtailable loads during “perfect storm” scenarios

# A. BASIC DESIGN STEPS

- Roof-top
- Ground-mount
- Tracking systems – single and dual axis
- Carports
- Shade structures



# CASE STUDY | Portland Community College

*Typical Ground-Mounted Solar Systems*



# CASE STUDY | Irvine Unified School District





# CASE STUDY | Rooftop Solar





# CASE STUDY | Shade Structures





# SRUSD | Shade Structure Potential





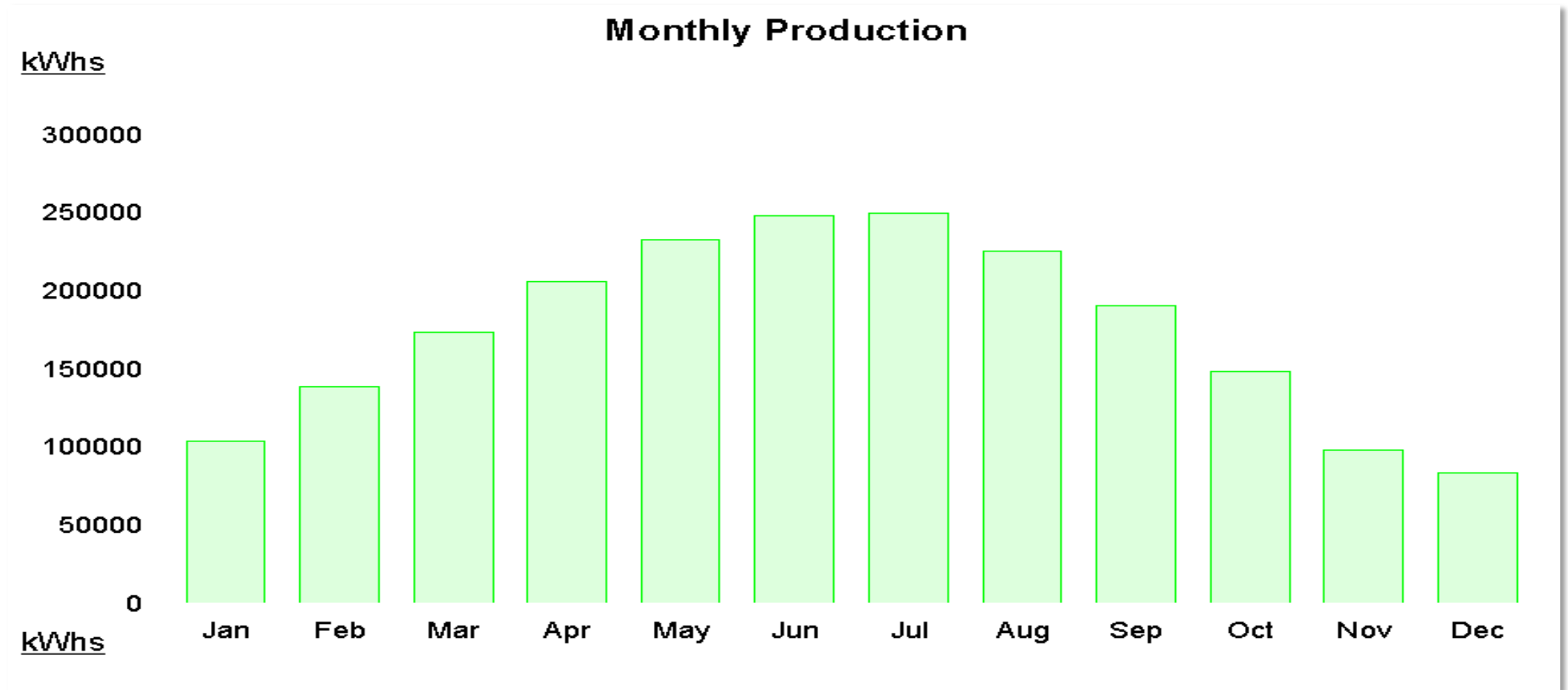
## B) SIZING THE SYSTEMS

- Sizing the systems
- Compromising with the probabilities
- The rate switch..
  - And rates never sleep! – they toss and turn!!

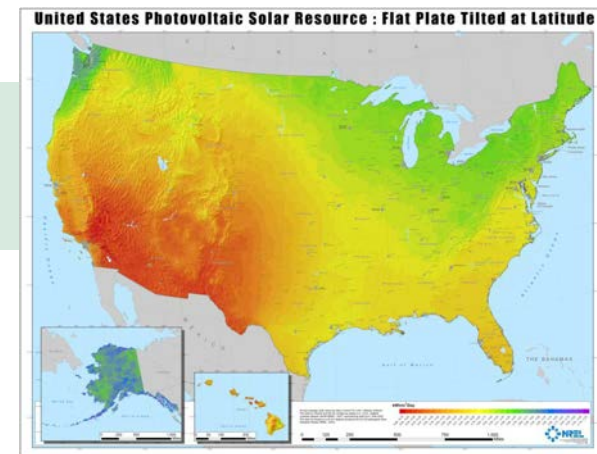
# Battery Back-up Goal

School	Average daily demand	7 hours of discharge
Bolsa Knolls MS	72 kW	504 kWh
Gavilan View MS	72 kW	504 kWh
La Joya ES	39 kW	273 kWh
McKinnon ES	47 kW	329 kWh
New Republic ES	78 kW	546 kWh
Santa Anita ES	75 kW	525 kWh
<b>Total</b>	<b>383 kW</b>	<b>2,681 kWh</b>

# Monthly Solar Generation Profile



# Bolsa Knolls Example



	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
<b>Avg Solar Peak kW 8AM to 3PM</b>	55.8	58.4	68.8	98.6	117.5	131.1	129.2	121.6	107.3	87.5	64.0	54.6
<b>times 7 hours</b>	390	409	482	690	822	918	904	851	751	613	448	382
<b>Battery kWh</b>	216	216	216	216	216	216	216	216	216	216	216	216
<b>Total back up kWh available</b>	606	625	698	906	1038	1134	1120	1067	967	829	664	598
<b>Goal</b>	504	504	504	504	504	504	504	504	504	504	504	504



# Probability Matrix

## The Sufficient Storage Probability Matrix

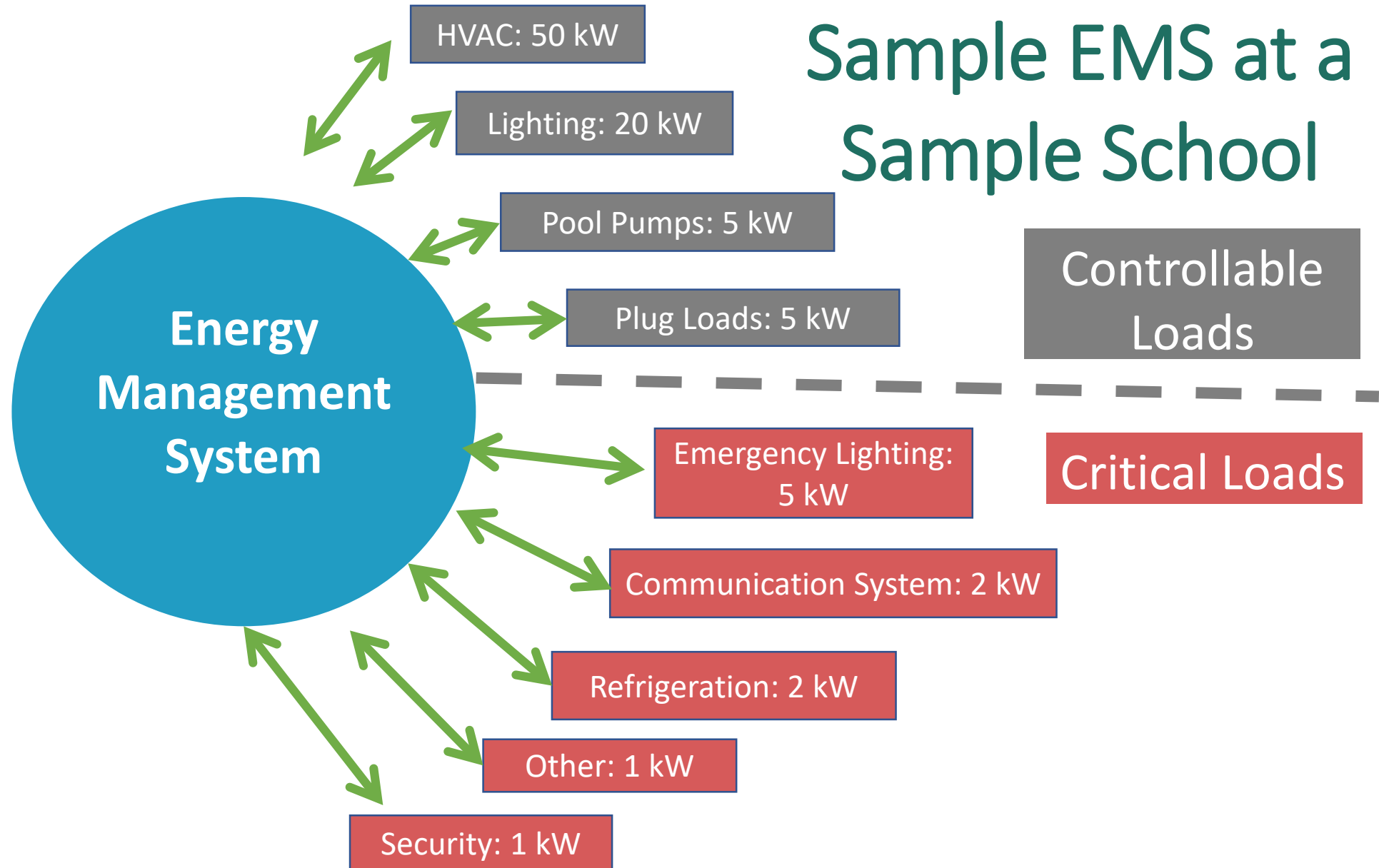
School	Power (kW)	Capacity (kWh)	Annual Site Load (kWh)	7+ hrs storage	6-7 hrs storage	5-6 hrs storage	4-5 hrs storage	3-4 hrs storage	2-3 hrs storage
Bolsa Knolls	90	216	8,102	94%	4%	1%	0%	0%	0%
New Republic	90	216	5,954	78%	14%	5%	2%	0%	0%
Santa Rita	100	240	2,653	87%	8%	4%	0%	0%	0%
Gavilan	100	240	2,766	87%	13%	1%	1%	0%	0%
La Joya	40	96	288	86%	5%	3%	4%	2%	0%
McKinnon	40	96	288	80%	7%	5%	4%	3%	1%

\* Based on average campus operations

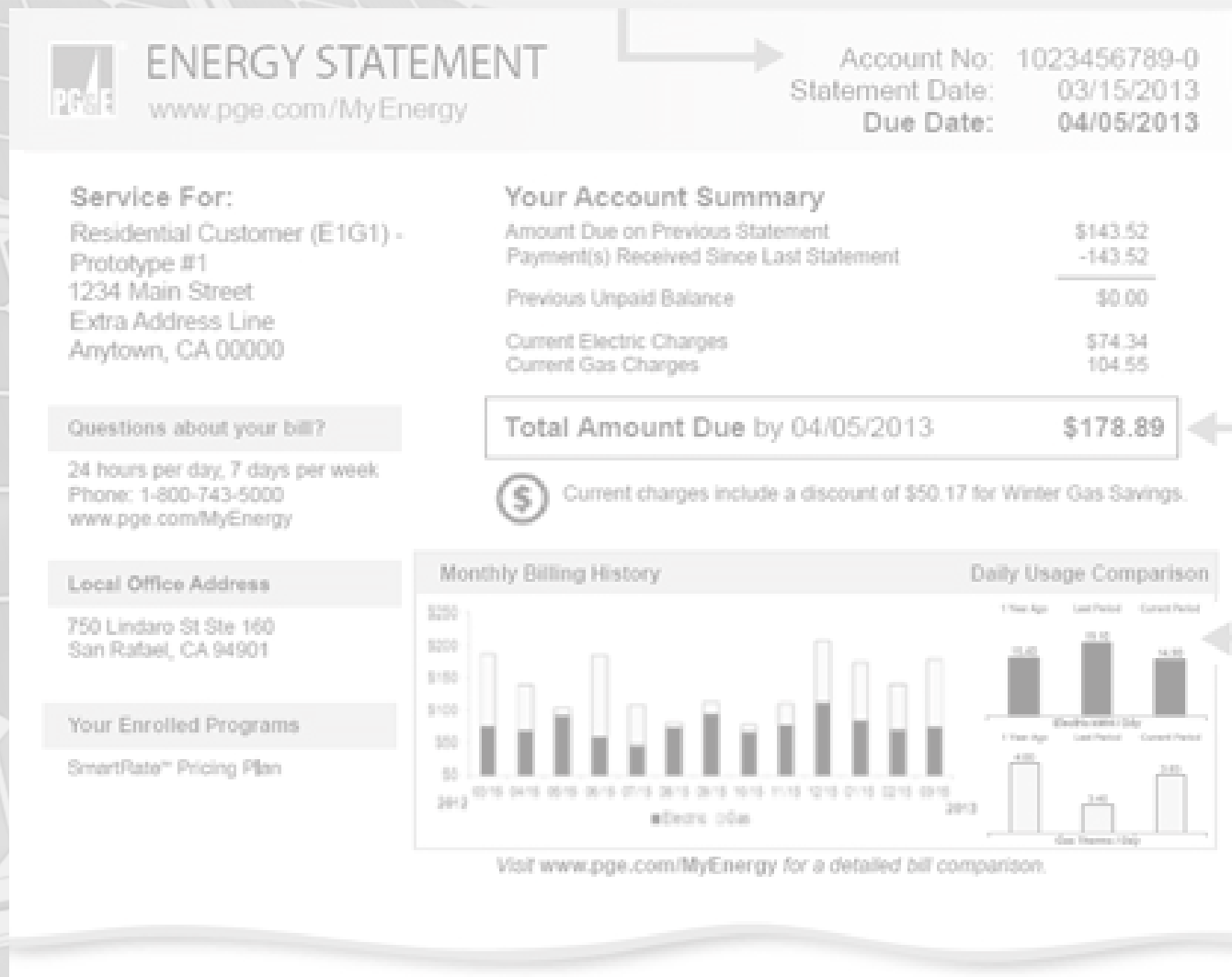
# Addressing “The Perfect Storm” ...

- All students have arrived on campus
- The macrogrid goes down at 8:15
- And it’s raining
  
- Campuses island and go into “Battery Mode”
- Curtailable loads are curtailed
  - HVAC now controlled wirelessly
  - Plug loads and other non-essential, controllable loads turned off
  - Only critical functions continue: lighting, communications, refrigeration

# Sample EMS at a Sample School



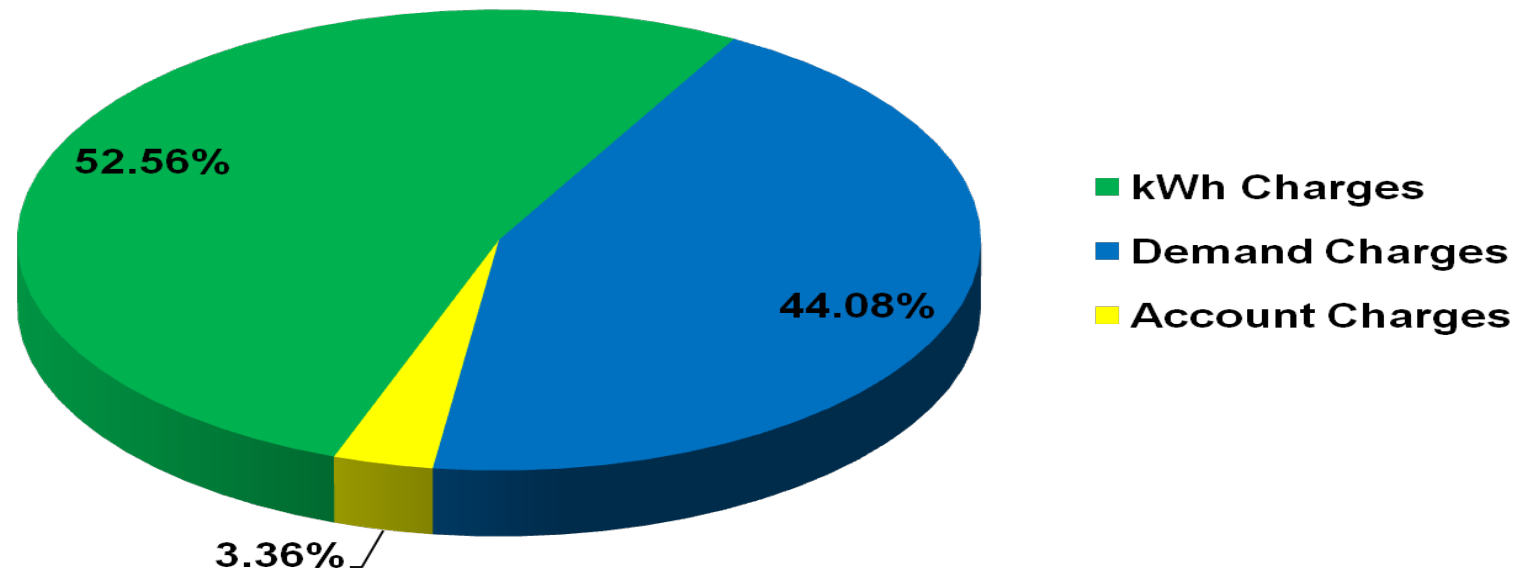
# C) THE RATE COMPONENT





# Understanding Electric Rates

## Demand Charges vs. Energy Charges



# Comparing Rates: A-10 vs A-6

## Time of Use Period

Summer Peak kWh  
Summer Mid-Peak kWh  
Summer Off-Peak kWh  
  
Winter Mid-Peak kWh  
Winter Off-Peak kWh

## A-10 TOU

\$ 0.21  
\$ 0.16  
\$ 0.13  
  
\$ 0.13  
\$ 0.11

## A-6

\$ 0.54  
\$ 0.24  
\$ 0.17  
  
\$ 0.19  
\$ 0.18

## Demand Charges

Summer (Peak/ kW)  
Summer Gen (Part Peak)

## A-10 TOU

\$ 16.37  
\$ 9.00

## A-6

\$ ZERO  
\$ ZERO

# Bolsa Knolls Example

## How Solar Energy Can Eliminate the PG&E Bill

Summer 159,841 kWh

Winter 173,161 kWh

Total Year 333,002 kWh

Annual Solar Generation

262,000 kWh

### Bolsa Knolls Meter usage on A-6 Rate

Summer	% Use	kWh	Rate	Bill
on peak	26%	41,559	\$ 0.54	\$ 22,633
mid peak	28%	44,755	\$ 0.25	\$ 11,090
off peak	46%	73,527	\$ 0.18	\$ 11,090

(No Demand Charges)

### Winter

mid	52%	90,044	\$ 0.19	\$ 17,468
off	48%	76,724	\$ 0.18	<u>\$ 15,830</u>

**Bill Total** \$ 78,112

### Bolsa Knolls on A-6 Rate with Solar

Summer	% Gen	Solar Gen	Rate	Credit
on peak	29.20%	76,504	\$ 0.54	<b>\$41,664</b>
mid peak	13.80%	36,156	\$ 0.25	<b>\$ 8,959</b>
off peak	18.50%	48,470	\$ 0.18	<b>\$ 8,540</b>

(No Demand Charges)

### Winter

mid	26.98%	70,688	\$ 0.19	<b>\$13,713</b>
off	11.52%	30,182	\$ 0.18	<b><u>\$ 5,306</u></b>

**Solar Offset Total** **\$78,183**

# Timing and the A6 Rate

- PG&E's A6 Rate was slated to expire, rate option window was closing
- SRUSD had to enact rate switch prior to installation of solar
- An entire summer of lost solar generation and paying high A6 summer rates





## D) SOLAR SYSTEM AND BATTERY LOCATIONS



Bolsa Knolls Middle School



Battery to be placed within the concrete walls at the electrical switchgear

Gavilan View Middle School



Battery to be placed within a fenced area at the electrical switchgear

La Joya Elementary School



Battery to be placed in a fenced area with the electrical switchgear

New Republic Elementary School



Battery to be placed in a grassy area with the electrical switchgear

Santa Rita Elementary School



Battery to be placed within a fenced area at the electrical switchgear  
5/4/2016

McKinnon Elementary School



Battery to be placed in a fenced area with the electrical switchgear



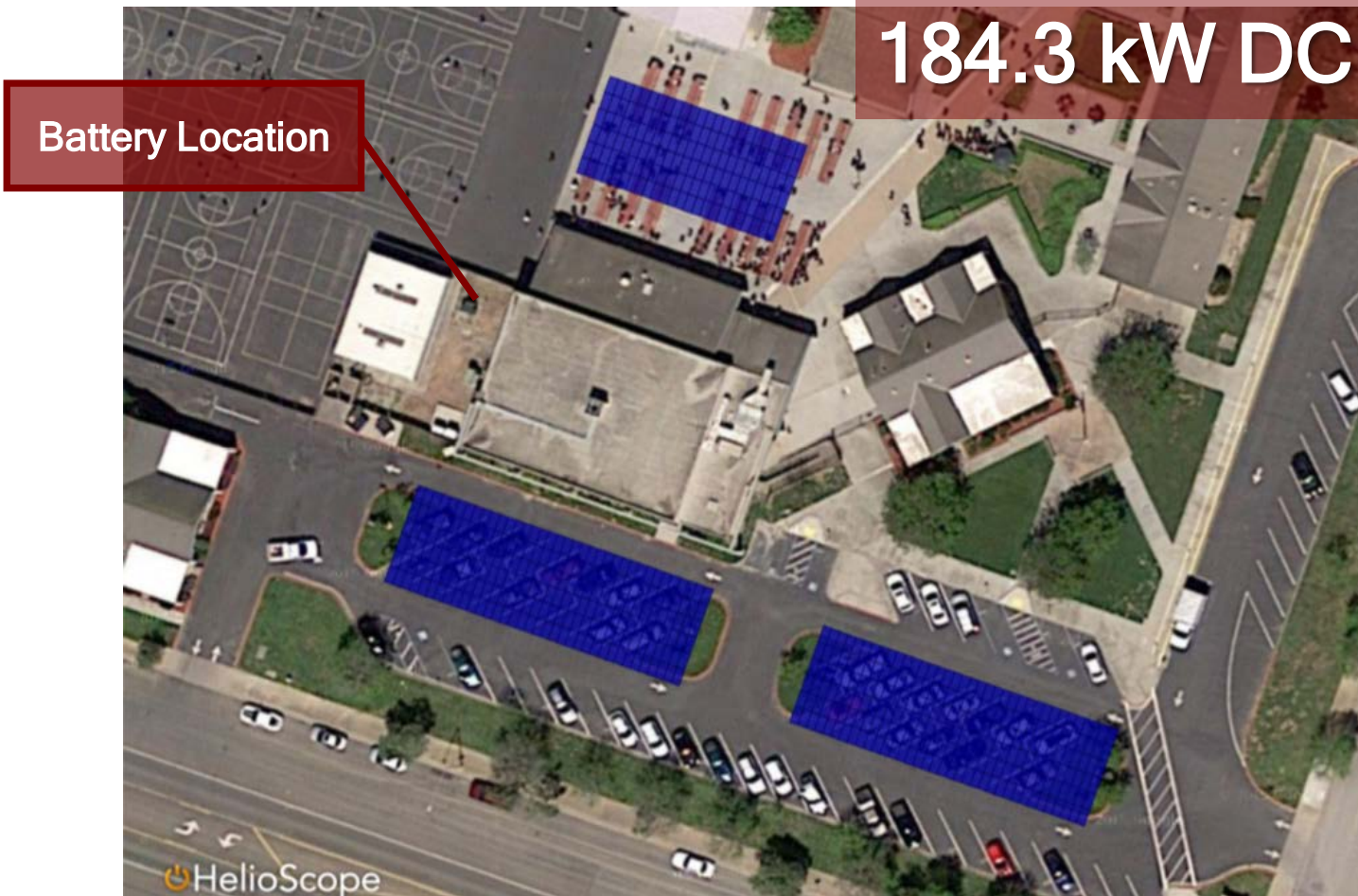
# New Republic Elementary School



163.8 kW DC (512 panels)

Battery Location

# Gavilan View Middle School



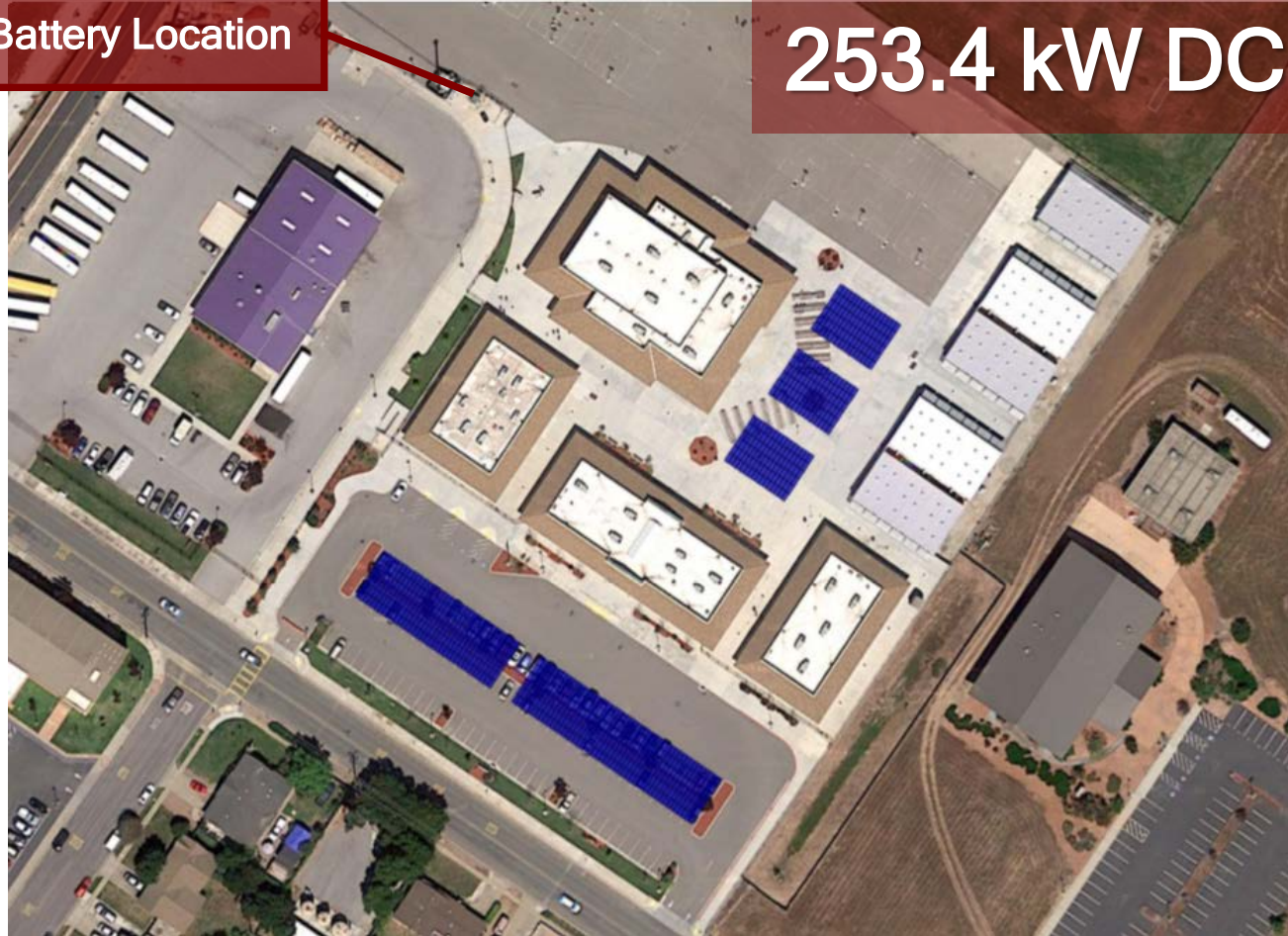
184.3 kW DC (576 panels)



# Bolsa Knolls Middle School

Battery Location

253.4 kW DC (792 panels)





## E) FINANCING

- SolEd proposal partner, C2SSG, drops out
- Not willing to tackle 7-hour batteries...
- SolEd approaches 17 other financiers
  - All are leery of the resiliency angle
  - Resiliency, generally, lacks a revenue stream

# Project Financiers Solicited to Buy the Project Included...

1. Altus Power America
2. Avalon and its financial partner
3. Blue Path Finance
4. Brightmark Energy LLC
5. Candle 3
6. Carreden Group
7. CSSI
8. C2SSg
9. East West Bank
10. Ensync and its financial partner
11. Capital
12. New Island Capital
13. Renew Energy Partners
14. Security Research Assoc.
15. Stem
16. US Bank
17. Wells Fargo
18. Zions Energy Link

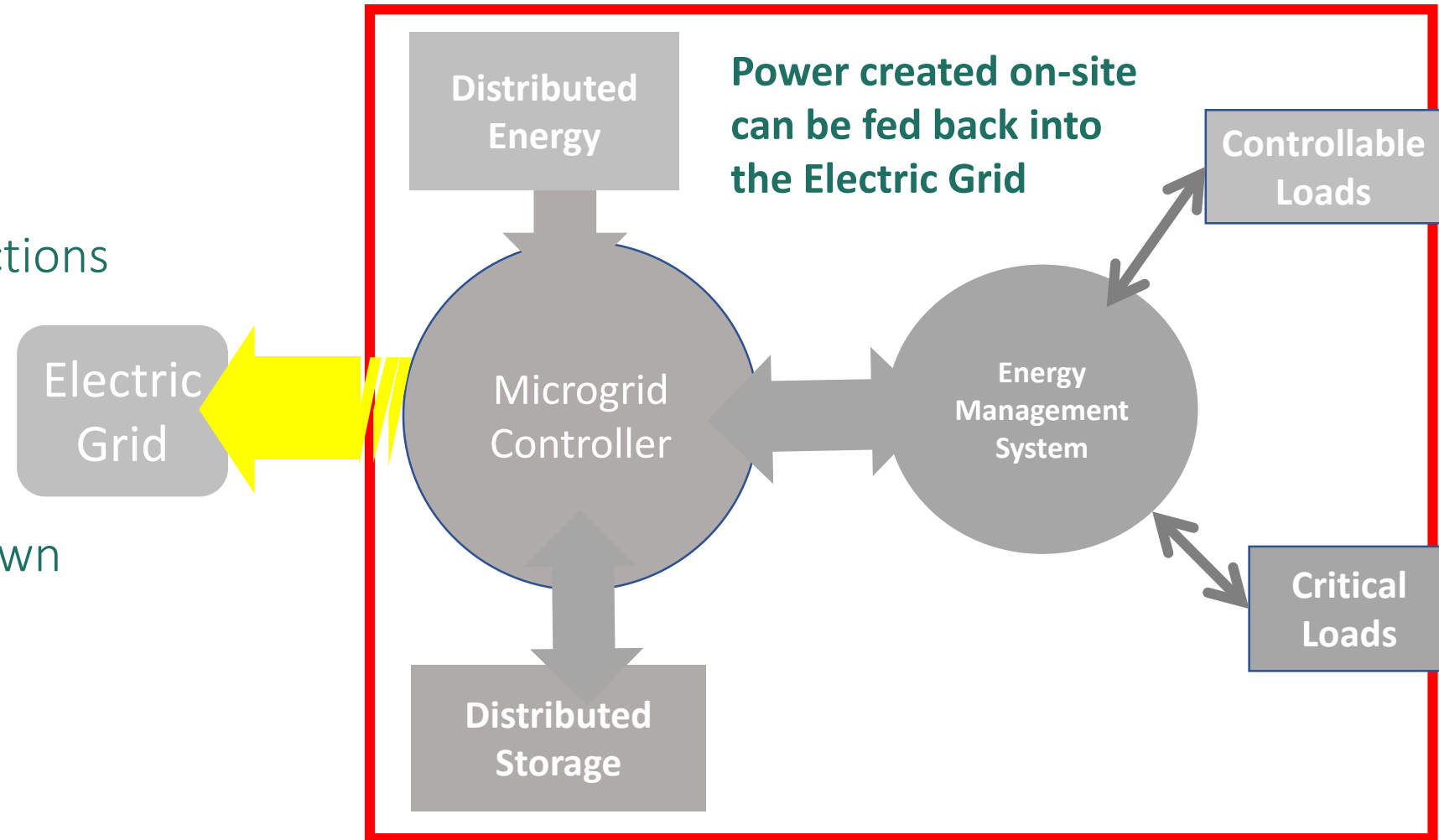
*At one point, SolEd's David Kunhardt, exasperated said, "The market is not ready to do this."*

# Generate Capital Takes on the PERC Model

- EcoMotion and SolEd urge Jigar Shah of Generate Capital to buy the project
- Generate Capital buys the project and promotes the model
- Eager to take on a 24 cent PPA
  - Insists on bankable technologies and project partners
  - Brings in MBL Energy, Sharp Energy Systems and Services, and Black & Veatch
- EcoMotion arranged that future asset management values will be split

# Potential Microgrid Secondary System Revenues

- **Utility Programs**
  - Demand response
  - Peak period capacity auctions
- **ISO Ancillary Services**
  - Frequency regulation up
  - Frequency regulation down
  - Voltage support
  - “Black start”





## F) Construction and the SRUSD Team

- Woman-owned MBL Energy becomes “Lead Contractor” for Engineering, Procurement, Construction
- Sharp provides software, integrates hardware, and ultimately serves as “Asset Manager” bound to performance guarantees
- Black & Veatch engineered the microgrid system
- Fully permitted with the Division of the State Architect; Interconnection with PG&E



# SRUSD Project Facts: Solar

## Portfolio Size:

Number of Solar Panels:

Solar Panel Make/Model

Inverters Make/Model:

Monitoring System:

**1,052 kW**

3,142

335-watt REC panels

16 Ideal Power string inverters

Also Energy/Deck

	kW	Panels	Annual kWh
<b>Bolsa Knolls MS and the MOT</b>	<b>264</b>	<b>787</b>	<b>403,036</b>
<b>Gavilan View MS and District Office</b>	<b>207</b>	<b>691</b>	<b>320,909</b>
<b>La Joya Elementary School</b>	<b>115</b>	<b>344</b>	<b>167,121</b>
<b>McKinnon ES and MCOE</b>	<b>143</b>	<b>428</b>	<b>223,124</b>
<b>New Republic Elementary School</b>	<b>156</b>	<b>456</b>	<b>244,263</b>
<b>Santa Rita Elementary School</b>	<b>167</b>	<b>499</b>	<b>261,461</b>

# SRUSD Project Facts: Batteries

<b>Portfolio Size</b>	<b>480 kW / 1,096 kWh</b>
<b>Number of Samsung racks</b>	<b>27, 30 kW units</b>
<b>Microgrid Solutions Provider</b>	<b>Sharp SmartStorage</b>

	<b>kW</b>	<b>kWh</b>
<b>Bolsa Knolls MS and the MOT</b>	<b>90</b>	<b>203</b>
<b>Gavilan View MS and District Office</b>	<b>120</b>	<b>284</b>
<b>La Joya Elementary School</b>	<b>30</b>	<b>81</b>
<b>McKinnon ES and MCOE</b>	<b>60</b>	<b>122</b>
<b>New Republic Elementary School</b>	<b>90</b>	<b>203</b>
<b>Santa Rita Elementary School</b>	<b>90</b>	<b>203</b>

## G) Long-Term Project Benefits

- During prolonged outages, the campuses will be powered by solar and storage for community energy resilience
- PERCs will provide:



**Cell Phone and EV/Ebus Charging**



**Medical and Triage support**

**Incident Command Centers**



**Emergency Sheltering**





# Disaster Preparedness

- SRUSD working with City of Salinas and Monterey County officials
  - City and County officials
  - Fire Departments
  - Police Departments
- SRUSD working with American Red Cross
  - Protocols for prolonged outages
  - Turning over campuses to Red Cross



# Teachable Moments in Monterey!

- Making every student, teacher, and staff member fully aware of the carbon-free microgrids and the islanding benefit!
- “Battery-mode drills” planned for each campus
- Student curricula being developed for each grade level
- Awareness program being developed for parents and the community
  - Linking in electric transportation

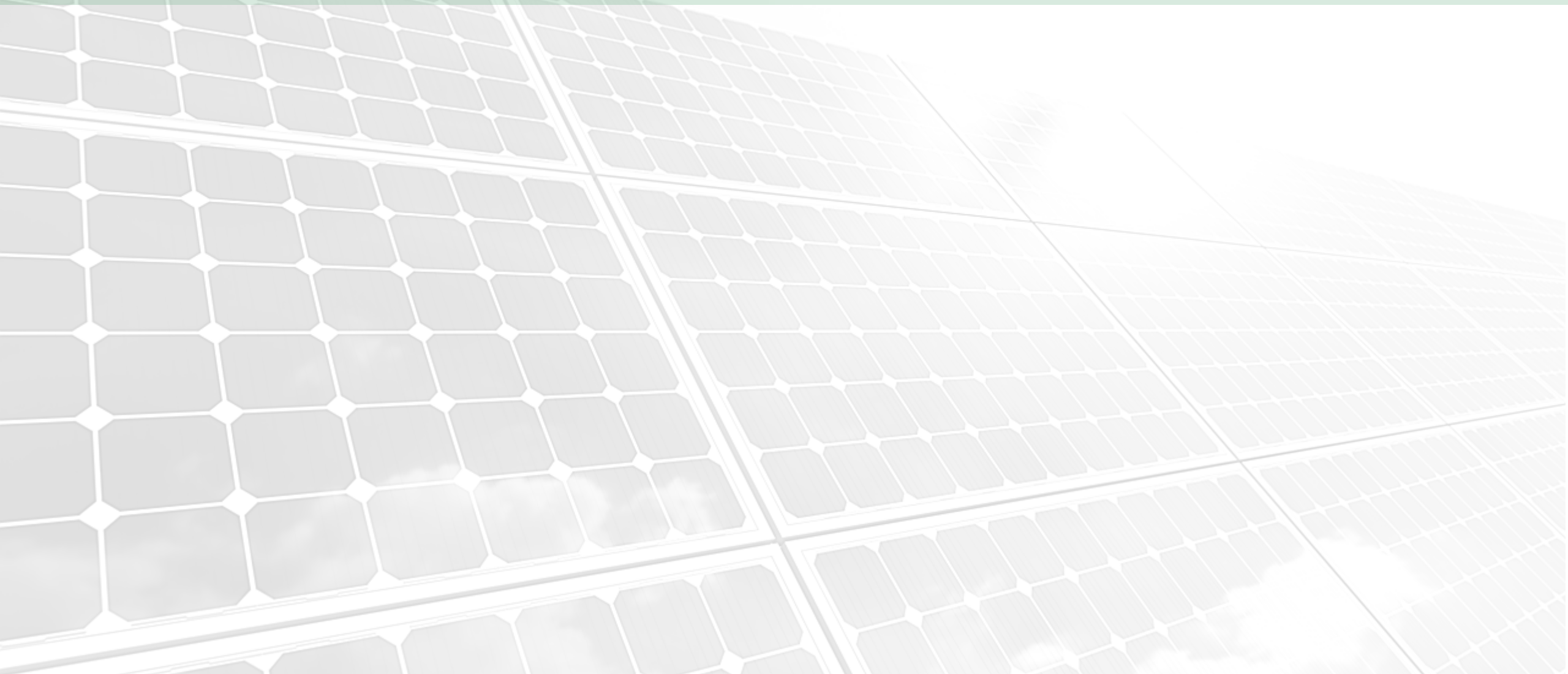


## 4) Scaling the PERC Model

- PERCs have many benefits
  - Maintain student education
  - Shelter in place
  - Long-term community and first-responder support
- PERCs make sense for
  - To campuses without solar
  - To campuses with solar (approximately 1,000 in California)
- PERCs make sense for other sectors too:
  - City facilities, universities, business parks, water works, neighborhoods, etc.



## 5) Bringing PERC's to Campbell Union High School District





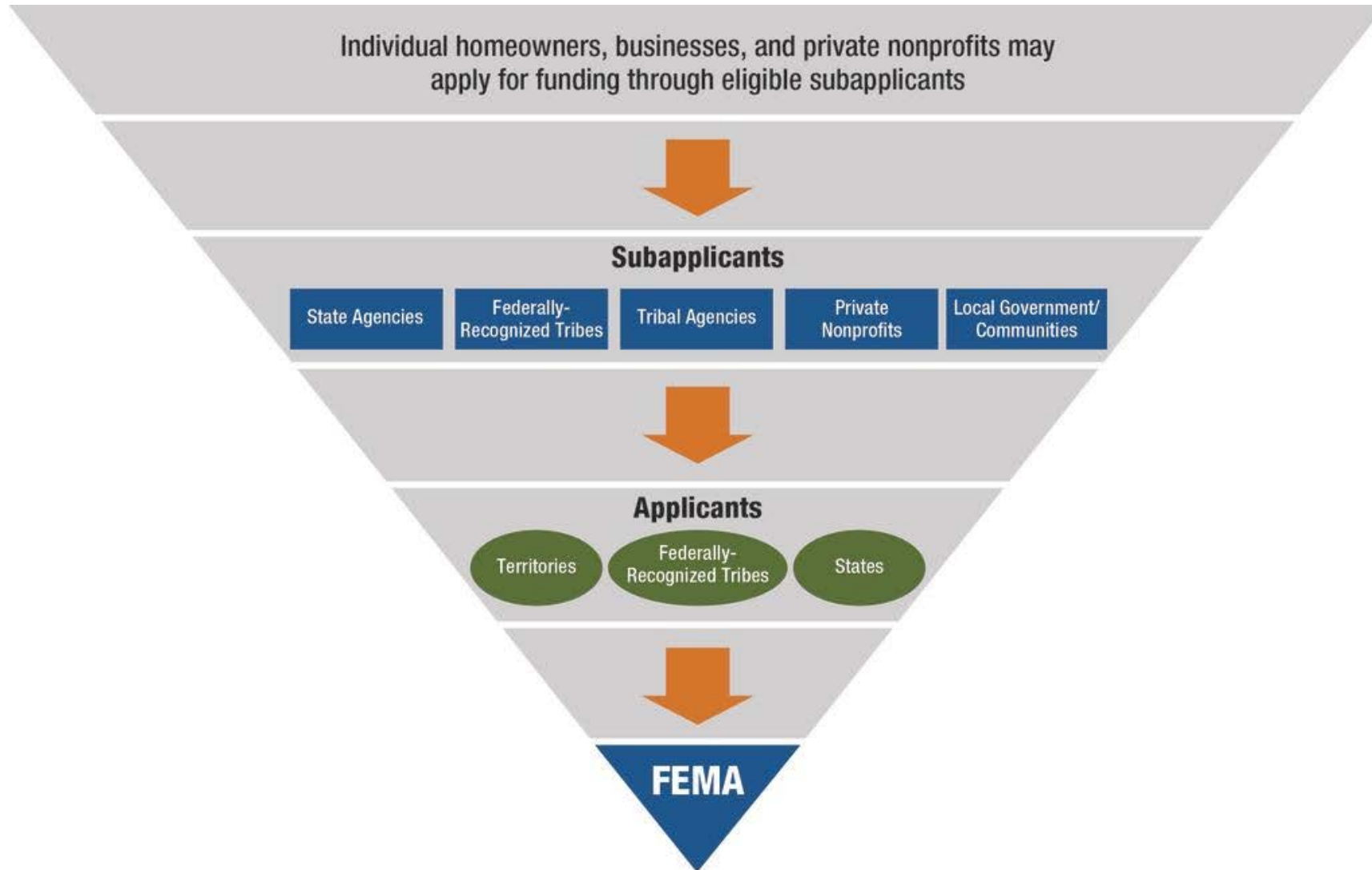
# EcoMotion's Work at CUHSD

- High school district currently has 3.7 MW of solar on five campuses
- CUHSD invested \$15 million in solar in 2012
- Led by Nancy Pfeiffer, CUHSD wants to make its campuses resilient
- Project goal is to “re-wire” these campuses with storage and controls
- EcoMotion seeking funds for CUHSD PERCs:
  - QZABs: Qualified Zone Academy Bonds (money received, redirected)
  - California Energy Commission (CEC) EPIC grants (project not funded)
  - Federal Emergency Management Agency (FEMA) 404 HGMP (in process)

# FEMA 404 HGMP

- Rolling program; variable funding
- FEMA has a number of eligibility categories for grant funds
  - Soil stabilization, wildfire mitigation, infrastructure retrofit, floodplain/stream restoration, flood diversion and storage,...
- “Generators” is an eligible category
- Multi-location application addresses multiple hazards (earthquake, forest fires, flooding, etc.)
- Maximum funding \$3 million; minimum match 25% (\$1,000,000)
- Application jurisdiction must have approved Local Hazard Mitigation Plan to be eligible for FEMA 404 program funds

# FEMA Application Process



# CUHSD and FEMA

- CUHSD partners with Santa Clara County which has LHMP
- Santa Clara County (project partner and “sub-applicant”) applies to the California Office of Emergency Services (CalOES)
- CalOES “applicant” applies to FEMA on behalf of CUHSD
- CUHSD passes through “Notice of Intent” in April 2018; CUHSD and SCC welcomed to submit grant sub-application.
- CUHSD submits grant sub-application on September 4, 2018
- CalOES can request additional information up to January 2019 prior to FEMA submittal
- We’ll keep you posted!



## 6) Lessons Learned



## Lesson #1

# Shoot for the Stars!

- The challenge at SRUSD seemed untenable
- The Board and administration pushed for solutions
- The Board and administration had a lot to learn, and digest to be ready to sign the PPA and make a 25-year commitment
- Board member Tom Spencer is shocked – and proud -- that SRUSD is the first to do this!
- The job required patience and great flexibility. There were unknown costs... like switchgear... and benefits, like SGIP incentives. There were timing and interconnection issues. The Board accepted the unknown values of asset management.

## Lesson #2

### Blending Resilience and Solar to Bring its Costs in Line

- Resilience – especially 7-hour battery storage variety – is expensive
- Resilience is like insurance. It's only valuable during catastrophe
- It can be paid for separately.... but this is a new and unbudgeted cost
- SRUSD was able to get resilience at parity by blending solar and storage and engaging an attractive rate option switch to reach parity
- Schools without solar may be able to blend solar with resilience...
- For districts that already have solar, a financing efficiency and resilience may achieve the same effect.

## Lesson #3

### Technology Flexibility was Needed to Seal the Deal

- SRUSD favored vanadium-flow batteries provided by Avalon Batteries
- Vanadium-flow batteries are inherently safer than lithium-ion, the latter which is flammable and at times volatile
- Several financial firms were uncomfortable with Avalon Battery's short tenure in the marketplace
- The flow battery technology and Avalon were deemed "un-financeable"
- Ultimately, SRUSD had to accept a more standard battery technology to get the deal done



## Lesson #4

### Rates always Change; and when “Grandfathering” is not

- The SRUSD project was developed based on a rate structure in place at the time (2016)
- By 2018, several major changes are proposed:
  - First, the time of use periods will shift radically. This will reduce the summer bill credits anticipated.
  - Second, the A6 rate – which was secured for SRUSD – will be grandfathered, but its values will change
- EcoMotion expects a 10 – 20% penalty given these rate changes.
- The lesson? Deals can only be crafted based on what we know now. Changes to rates can negatively affect a project

## Lesson #5

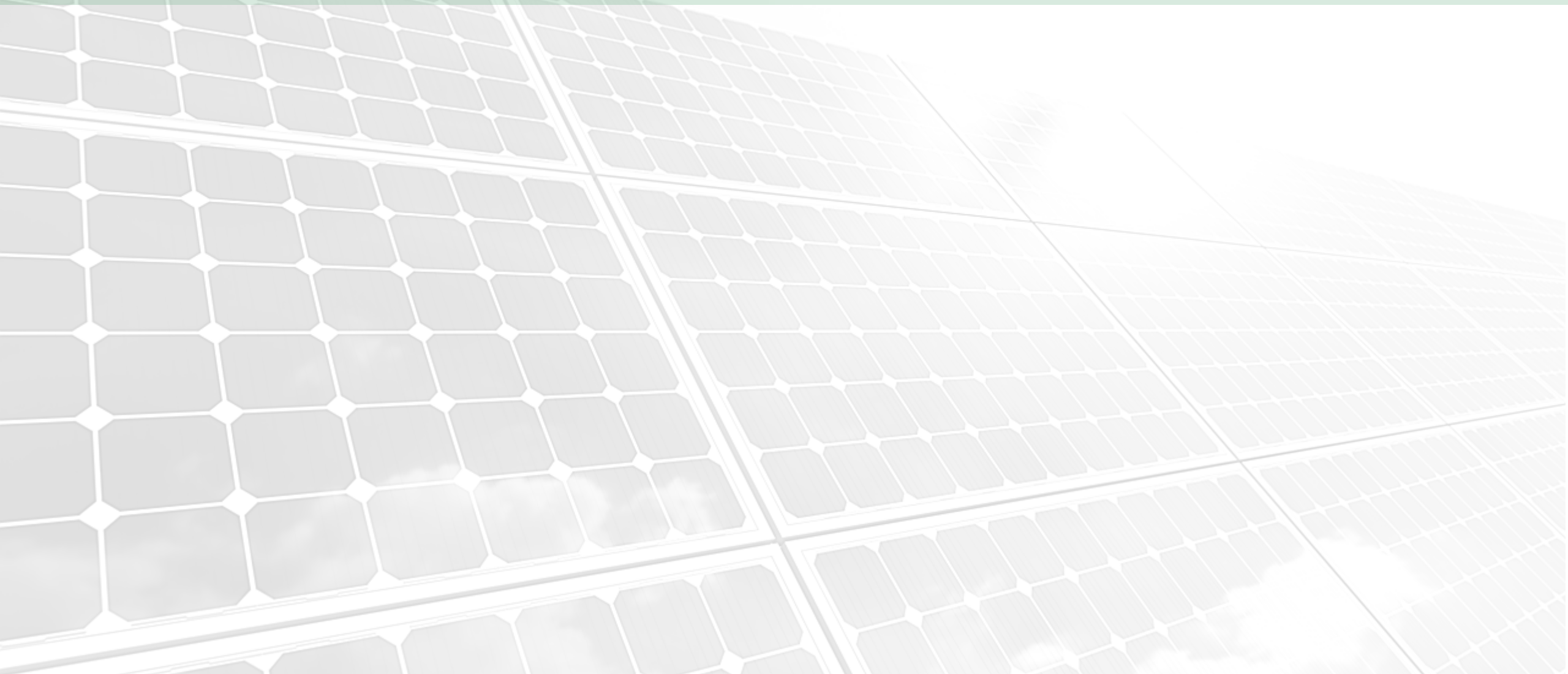
# The Need for Regulatory Reform and SB 1339

- System completely built by December 2017; final connections in January 2018
- Time required for PG&E's permission to operate: January – September 2018. Team filed complaint with CPUC
- State policy to promote microgrids: 2014 \$26.5 million solicitation, and \$47 million in 2018
- But microgrids have been stymied by unclear regulatory path
- The SRUSD case study makes it clear that there is a strong need for consistent utility rules, and interconnection regulations
- Recent passage of SB 1339 by California Senate and Assembly on August 31 is encouraging
- SB 1339 is intended to bring more predictability to microgrid development; enabling growth of microgrids and their benefits
- When signed into law, the bill will require utilities to take action to support microgrids, such as creating special tariffs, streamlining interconnection standards and permitting

For additional information, please access EcoMotion White Papers at [www.EcoMotion.us](http://www.EcoMotion.us), and visit “Media”

- “The Lithium-Ion, Hybrid Electric Building Revolution,” February 2016
- “Creating Microgrids and PERCs: Powered Emergency Response Centers,” April 2017
- “Ancillary Services from Distributed Storage,” February 2017
- “The SRUSD Case Study White Paper,” September 2018

## 7) Questions & Answers





# Thankyou!



**For more information, please contact**

**Ted Flanigan, President (949) 292 – 7314 | [TFlanigan@EcoMotion.us](mailto:TFlanigan@EcoMotion.us)**